

TECHNICAL MEMORANDUM**NE 179th Street at NE 29th Avenue and NE 50th Avenue Intersections**

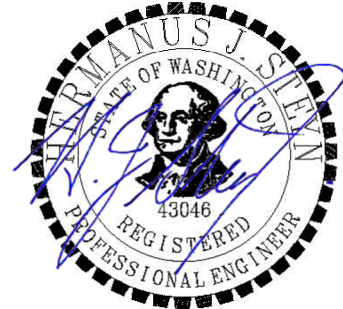
Date: May 12, 2020

Project #: 207170.018

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Subject: Traffic Control Alternative Analysis



02/12/2020

Clark County Department of Public Works is planning to widen NE 179th Street from Interstate 5 (I-5) to beyond NE 50th Avenue to a five-lane cross-section to support the long-term plans for the corridor. Kittelson & Associates, Inc. (Kittelson) analyzed traffic control alternatives at two intersections along the NE 179th Street corridor: NE 29th Avenue and NE 50th Avenue (Study Intersections). Preliminary engineering and right-of-way acquisition are anticipated in 2020-2021 with construction likely in 2022-2023. This memorandum summarizes the analysis findings.

This memorandum is organized into the following sections:

- Introduction
- Clark County Information and Analyses
- Scope and Analysis Methodology
- Existing Conditions
- Opening Year 2023 Operational Evaluation
- Horizon Year 2043 Operational Evaluation

**NE 179th Street/NE 29th Avenue: Looking South**

- Alternatives Development
- Safety Performance Analysis
- Life Cycle Cost Analysis
- Findings and Conclusions
- References
- Appendices



NE 179th Street/NE 50th Avenue: Looking North

SUMMARY

Based on the analysis summarized in this memorandum, the roundabout alternatives for both the NE 29th Avenue and the NE 50th Avenue intersections within the NE 179th Street corridor project are expected to perform better than the signalized intersection alternatives.

The long-range plan for NE 179th Street indicates that this corridor will have a five-lane cross section. Based on the year 2043 traffic operations analyses, it is unusual for a 20-year analysis showing signal and roundabout alternatives to operate at level of service (LOS) A/B. To investigate further, Kittelson conducted a sensitivity analysis with a three-lane cross-section along NE 179th Street. The sensitivity analysis projects the signals and roundabouts will operate at LOS B/C in the year 2043 with remaining capacity flexibility. Kittelson understands that the five-lane versus three-lane discussion is outside the scope of this project but recommends that the County revisit future planned improvements along NE 179th Street. A three-lane cross-section with single-lane roundabouts will significantly reduce property and natural resource impacts and project costs.

SCOPE AND ANALYSIS METHODOLOGY

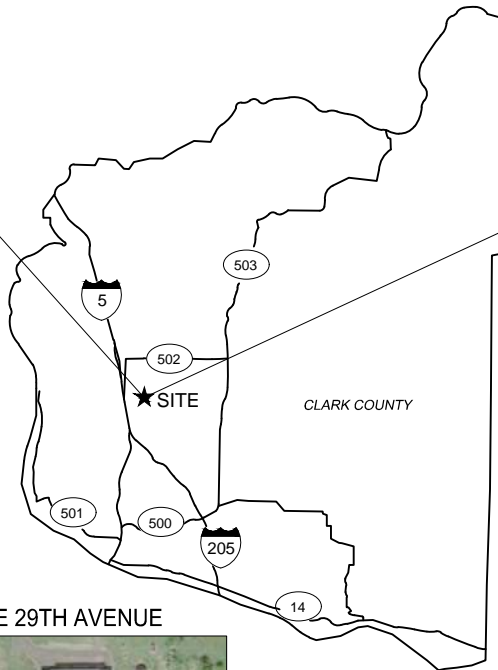
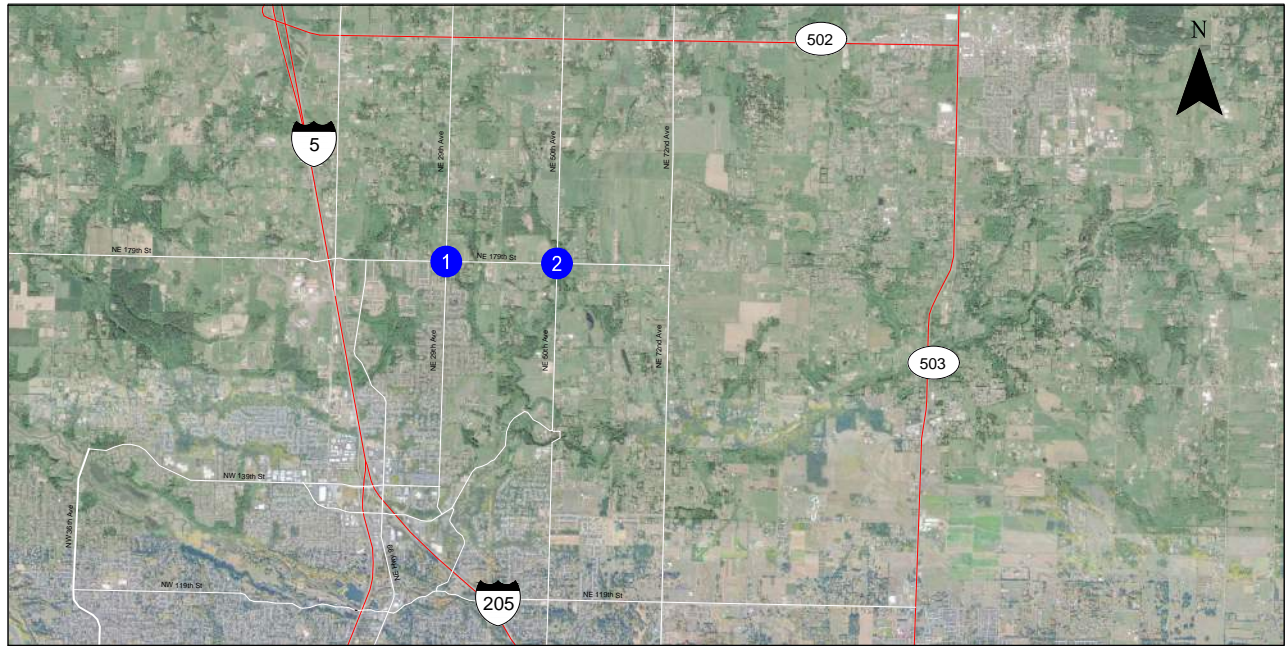
Kittelson completed this traffic control alternatives analysis in support of the County's operations analyses and preliminary engineering efforts. This study was prepared to help the County evaluate whether to provide roundabouts or traffic signals at two key intersections along the project corridor. Figure 1 displays the site vicinity map and the corridor area. The study intersections are:

- NE 179th Street/NE 29th Avenue
- NE 179th Street/NE 50th Avenue

This technical memorandum documents the analysis methodology, performance criteria, findings, and recommendations. The technical appendices offer a summary of data collected and analysis worksheets.

Kittelson's scope of services for this evaluation was limited to the following items:

- Summarizing analyses and designs prepared by Clark County staff
- Evaluating safety performance
- Computing life cycle cost



NE 179TH STREET / NE 29TH AVENUE



NE 179TH STREET / NE 50TH AVENUE



- Study Intersections

Site Vicinity Map
Clark County, WA

Figure
1

Clark County provided all other information and conducted the following activities:

- 2019 existing count data
 - Turning movement counts for the two study intersections
 - Tube counts on all approaches
- Crash data (i.e., shapefile and Excel format)
- Base 2015 and future 2040 Southwest Washington Regional Transportation Council (SWW RTC) model plots
 - The model plots reflect future connections based on adopted plans
- Traffic volume spreadsheet
 - Showing how growth from the model was calculated and applied to the 2019 existing counts, including balancing as needed
- Operations analyses
 - Synchro analysis
 - Existing weekday AM and PM peak hours
 - Future weekday AM and PM peak hours
 - SIDRA analysis for roundabouts
 - Future weekday AM and PM peak hours
- Arterial atlas
 - Typical design cross-sections
 - Street network by functional class
- Conceptual layouts of intersection configurations at study intersections
 - Signals
 - Multilane roundabouts
- Conceptual construction cost for each of the intersection alternatives at both study intersections

VOLUME DEVELOPMENT

New development is expected in the area in the coming years, which adds some urgency to this particular project. Clark County derived the study intersection traffic volumes using the following methodology:

1. The Southwest Washington Regional Transportation Council (RTC) provided weekday AM and PM peak hour travel demand model forecast volumes to Clark County staff for base year 2015 and

future year 2040 conditions. Variations in land use and transportation system connectivity (i.e., new roadway facility connections) are assumed in the forecast based on the County's Comprehensive Plan and Arterial Atlas. The RTC model data are in Appendix A.

2. Clark County staff post-processed the 2015 and 2040 forecast volumes. Annual growth rates were determined using the volume differences between the base year 2015 and future year 2040 TDM volumes, and then they were projected to future year 2023 and 2043 volumes. The 2023 and 2043 traffic volume projections prepared by Clark County staff are in Appendix B.

ALTERNATIVE OPERATIONS ANALYSIS

The following time spans represent the morning and evening peak periods:

- Weekday morning peak period (7:00 a.m. to 9:00 a.m.)
- Weekday evening peak period (4:00 p.m. to 6:00 p.m.)

Clark County staff conducted the existing (year 2019) and future (year 2023 and 2043) study intersection performance using the following operations analysis performance standards and methodology:

- County intersection standard thresholds for signalized intersections and roundabouts, defined as follows (Reference 1):
 - Control delay is defined to include initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay. Using this definition, LOS D, defined as 35 to 55 seconds of control delay per vehicle, is generally considered the minimum acceptable design standard.
- Signalized intersection analyses were conducted using the methodology of the *Highway Capacity Manual*, Sixth Edition (Reference 2), as implemented in Synchro 10 traffic analysis software using Washington State Department of Transportation (WSDOT)-specific guidance on Synchro implementation (Reference 3 & 4).
- Roundabout analyses were conducted using WSDOT SIDRA settings: These are the settings recommended by WSDOT for analyzing their facilities (Reference 5). Key settings include the following:
 - SIDRA Standard Model
 - Environmental factor of 1.0
 - LOS thresholds set equal to those for signalized intersections
- Although not explicitly shown in the operations sections of this report, off-peak periods were included in the estimates of annual delay that factor into the life-cycle cost evaluation presented later in this report.

ALTERNATIVES SAFETY ANALYSIS

Clark County staff reviewed and documented the study intersections' crash history. Kittelson compared the projected safety performance of the two alternatives (roundabout and traffic signal) at a planning level using the FHWA Safety Performance for Intersection Control Evaluation (SPICE) tool (Reference 6). This tool implements safety performance functions (SPFs) and crash modification factors (CMFs) provided in the *Highway Safety Manual (HSM)*, Reference 7). Per the WSDOT Safety Analysis Guide, Kittelson applied calibration factors of 1.00 to the *HSM* SPFs used in the model (Reference 8). The *HSM* SPFs are established for a range of common intersection and interchange configurations and are implemented in SPICE to allow comparisons across configurations under the same opening year and design year volume conditions.

ALTERNATIVES DEVELOPMENT

Clark County developed initial functional layouts for signal and roundabout alternatives at each of the intersections. This assumes that NE 179th Street will have a five-lane cross-section in the future. Key future characteristics of NE 179th Street are summarized in Table 1.

Table 1. Future Characteristics of NE 179th Street

Roadway	Classification ¹	Number of Lanes	Speed Limit (mph)	Raised Median	Side-walks	Bicycle Lanes	On-Street Parking	Surface
NE 179 th Street	Principal Arterial	5	50	Yes	Yes	Yes	No	Paved

¹ Functional classification provided from the Clark County, WSDOT Functional Classification Map Online.

Should roundabouts be selected for advancement, Kittelson will review these initial layouts and work collaboratively with County staff to refine the geometry based on the latest national best practices for roundabout designs.

ALTERNATIVES LIFE-CYCLE COST ANALYSIS

Kittelson computed life-cycle cost estimates using the *National Cooperative Highway Research Program (NCHRP) Project 03-110* methodology (Reference 9). The evaluation compared predicted safety performance between intersection types using the *HSM* crash prediction model and was predicated on preliminary project costs for each intersection control type.

EXISTING CONDITIONS

This study focuses on the NE 29th Avenue and NE 50th Avenue study intersections with NE 179th Street, located one and two miles respectively to the east of the I-5/NE 179th Street interchange. Key attributes of the existing roadway network are summarized in Table 2.

Table 2. Existing Transportation Facilities

Roadway	Classification ¹	Number of Lanes	Speed Limit (mph)	Raised Median	Side-walks	Bicycle Lanes	On-Street Parking	Surface
NE 179 th Street	Principal Arterial	2	40	No	No	No	No	Paved
NE 29 th Avenue	Minor Arterial	2	35-40 ²	No	No	No	No	Paved
NE 50 th Avenue	Minor Arterial	2	40-50 ³	No	No	No	No	Paved

¹ Functional classification provided from the Clark County, WSDOT Functional Classification Map Online.

² Speed limit is 40 mph north of NE 179th Street and 35 mph south of NE 179th Street

³ Speed limit is 50 mph north of NE 179th Street and 40 mph south of NE 179th Street

There is currently no fixed-route transit service serving the 179th Street Corridor study area.

EXISTING INTERSECTION OPERATIONS

Kittelson conducted a field visit in April 2020 to verify roadway characteristics, lane configurations, and geometric features at the study intersections. There is a vertical crest curve on NE 179th Street approximately 330 feet east of NE 29th Avenue. There is a vertical crest curve on NE 50th Avenue approximately 275 feet north of NE 179th Avenue.



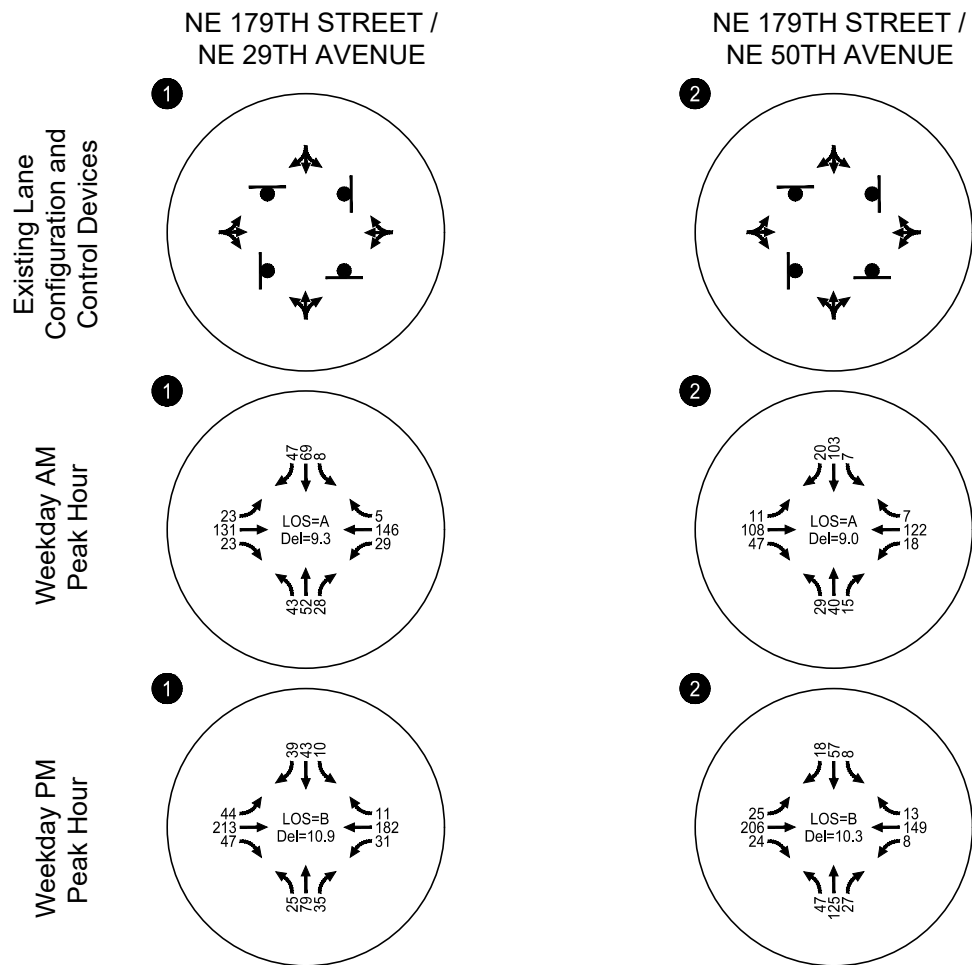
**NE 179th Street/NE 29th Avenue:
Looking East**



**NE 179th Street/NE 50th Avenue:
Looking North**

Quality Counts, LLC collected traffic volumes at the two study intersections on September 26, 2019. Based on the traffic counts, the weekday morning peak hour was found to occur between 7:55 and 8:55 a.m. and the evening peak hour between 4:15 and 5:15 p.m. The traffic counts are in Appendix C.

The existing study intersections are all-way stop-controlled (AWSC). Existing lane configurations and traffic control devices are shown in Figure 2. Clark County conducted the operations analysis for the existing conditions. Both study intersections currently satisfy County performance standards during the weekday AM and PM peak hours. Existing volumes and intersection operations are shown in Figure 2. Synchro HCM Reports are in Appendix D.



Existing Lane Configurations, Traffic Control Devices, and Conditions
Weekday AM and PM Peak Hours
Clark County, WA

Figure
2

LOS = INTERSECTION LEVEL OF SERVICE
Del = INTERSECTION AVERAGE CONTROL DELAY

CRASH SUMMARY

Kittelson summarized the crash data provided by Clark County for the two study intersections for the period from January 2015 through January 2020. The full crash data provided by Clark County staff is in Appendix E. Table 3 summarizes the crash data.

Table 3. Intersections with NE 179th Street Crash Summary (January 2015 through January 2020)

Location	Collision Type		Severity	
	Angle	Fixed Object	PDO ¹	Injury
NE 29 th Ave intersection	10	1	6	5
NE 50 th Ave intersection	2	2	3	1

¹Property Damage Only

OPENING YEAR 2023 OPERATIONAL EVALUATION

The opening year evaluation describes projected study intersection operations under 2023 traffic conditions, assuming NE 179th Street has a five-lane cross-section at study intersections.

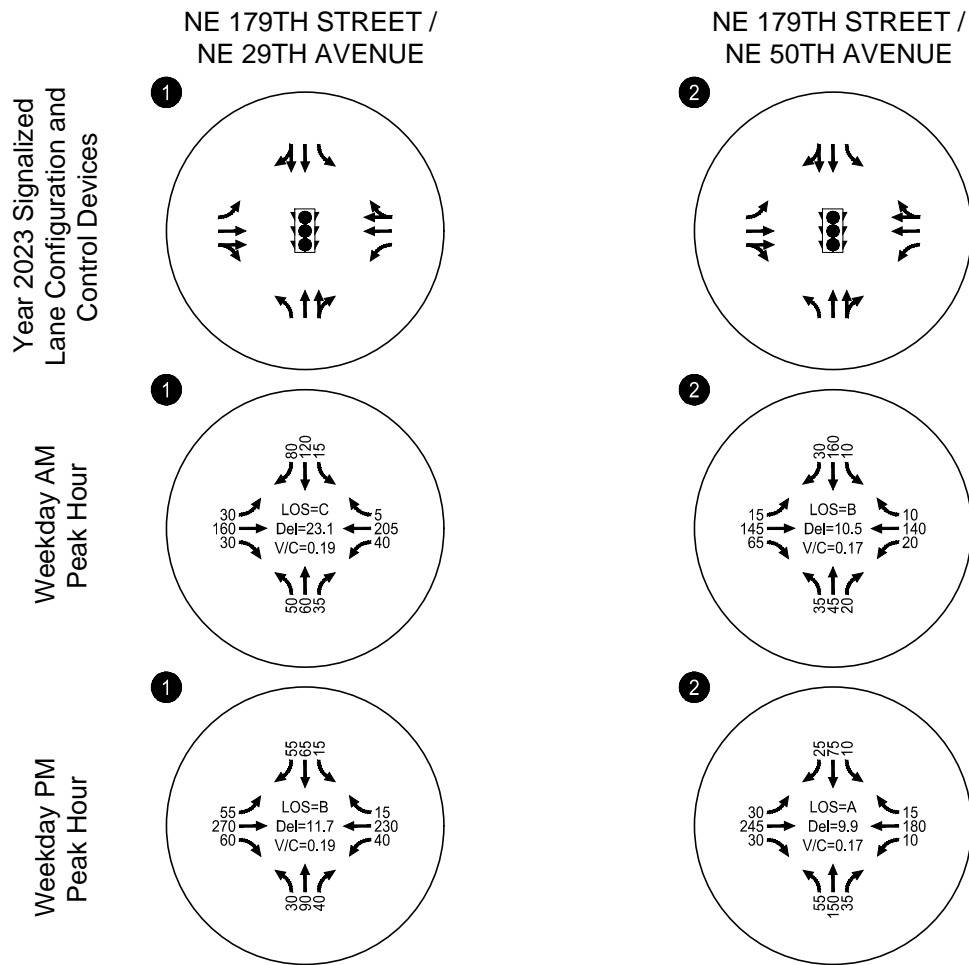
TRAFFIC SIGNAL ALTERNATIVE

Both intersections were projected to operate acceptably during peak hours (LOS C or better) when configured as traffic signals. The 2023 opening year volumes, lane configurations, and operations are shown in Figure 3. Synchro *HCM* reports prepared by Clark County staff for year 2023 conditions are in Appendix F. The traffic signal alternative analysis assumes:

- Typical signal configuration with detection and actuated phases;
- Protected-permissive left turns; and
- Assumed cycle lengths of 120 seconds, allowing the signals along the NE 179th Street Corridor to be coordinated in the future.

MULTILANE ROUNDABOUT ALTERNATIVE

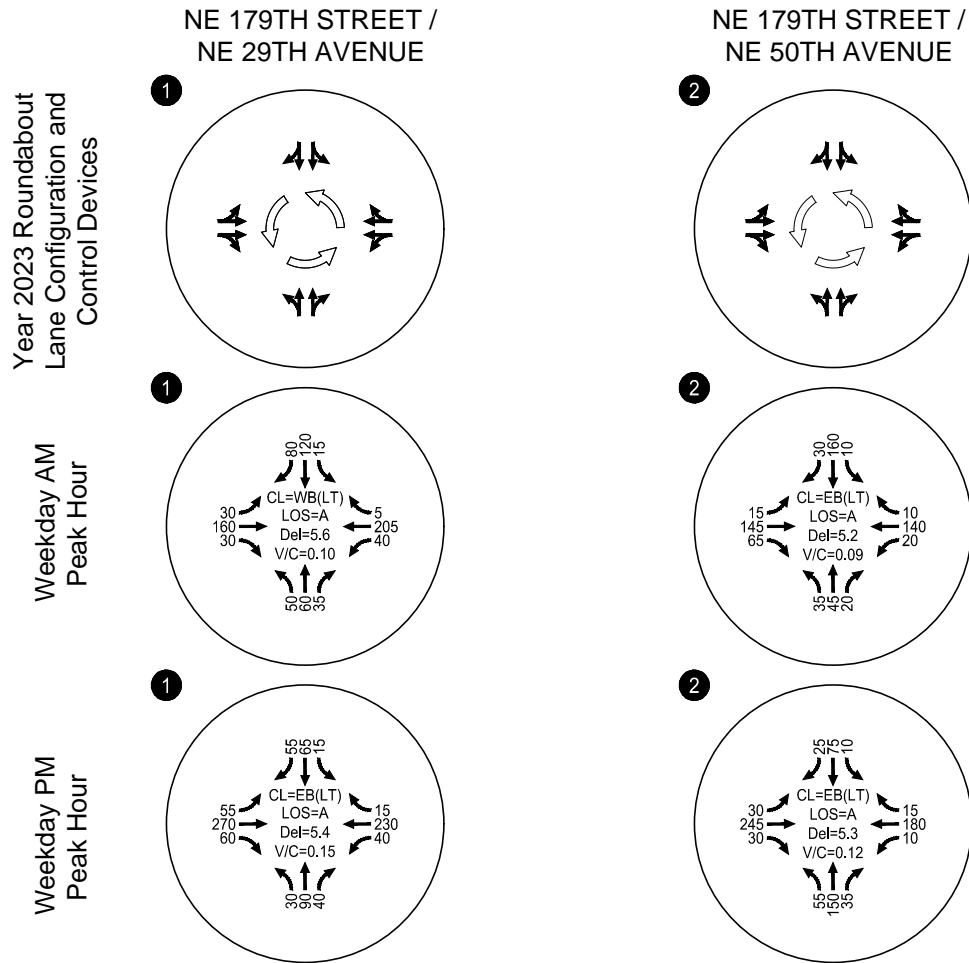
Both intersections were projected to operate acceptably during peak hours (LOS A) when configured as multilane roundabouts with lower delay than the signalized alternatives. The lane configurations of multilane roundabout alternatives assume shared left-through and shared through-right lanes on all approaches. The opening year 2023 volumes, lane configurations, and roundabout operations are shown in Figure 4. The results show critical movement at the roundabouts operate with less delay than at the stop-controlled intersections during both peak hours. SIDRA reports prepared by Clark County staff for year 2023 conditions are in Appendix G.



Year 2023 Signalized Lane Configurations and Traffic Conditions
Weekday AM and PM Peak Hours
Clark County, WA

Figure
3

LOS = INTERSECTION LEVEL OF SERVICE
Del = INTERSECTION AVERAGE CONTROL DELAY
V/C = INTERSECTION VOLUME-TO-CAPACITY RATIO



**Year 2023 Roundabout Lane Configurations and Traffic Conditions
Weekday AM and PM Peak Hours
Clark County, WA**

**Figure
4**

LOS = INTERSECTION LEVEL OF SERVICE
Del = INTERSECTION AVERAGE CONTROL DELAY
V/C = INTERSECTION VOLUME-TO-CAPACITY RATIO

HORIZON YEAR 2043 OPERATIONAL EVALUATION

The horizon year evaluation describes projected operations under year 2043 traffic conditions assuming NE 179th Street has a five-lane cross-section and other planned development and roadway projects are completed. The year 2043 performance analysis and evaluation include intersection operations, safety performance, and life cycle cost analysis assuming either traffic signals or multilane roundabouts.

TRAFFIC SIGNAL ALTERNATIVE OPERATIONS

The intersections were projected to operate acceptably (LOS C or better) during the weekday AM and PM peak hours. Horizon year 2043 volumes, lane configurations, and signal operations are shown in Figure 5. Synchro *HCM* reports prepared by Clark County staff for year 2043 conditions are in Appendix H.

ROUNDBABOUT ALTERNATIVE OPERATIONS

The two intersections were also analyzed as multilane roundabouts. The analysis results show the intersections operate acceptably as roundabouts (LOS A) during the weekday AM and PM peak hours. Horizon year 2043 volumes, lane configurations, and roundabout operations are shown in Figure 6. SIDRA reports prepared by Clark County staff for year 2043 conditions are in Appendix I.

ALTERNATIVES PERFORMANCE COMPARISON

Table 4 summarizes intersection operations results for each alternative.

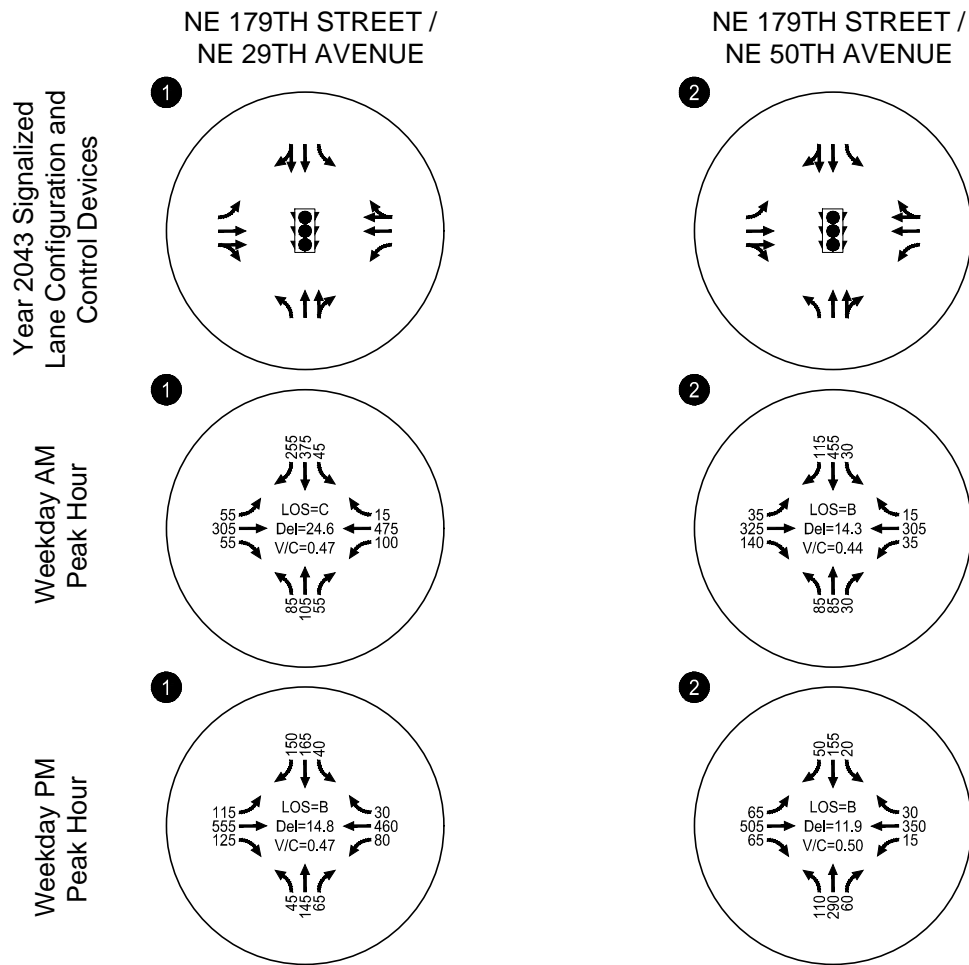
Table 4. 2043 Traffic Operation Analysis Summary

Intersection	Time Period	Year 2043 – Signals			Year 2043 - Roundabouts		
		INT ¹ Delay	INT ¹ V/C	INT ¹ LOS	CL ² (V/C)	INT ¹ Delay	INT ¹ LOS
NE 179 th Street/ NE 29 th Avenue	AM	24.6	0.47	C	SBLT (0.33)	6.3	A
	PM	14.8	0.47	B	EBLT (0.33)	6.1	A
NE 179 th Street/ NE 50 th Avenue	AM	14.3	0.44	B	SBLT (0.27)	5.0	A
	PM	11.9	0.50	B	EBLT (0.26)	5.9	A

¹ INT = Average intersection

² CM = Critical movement

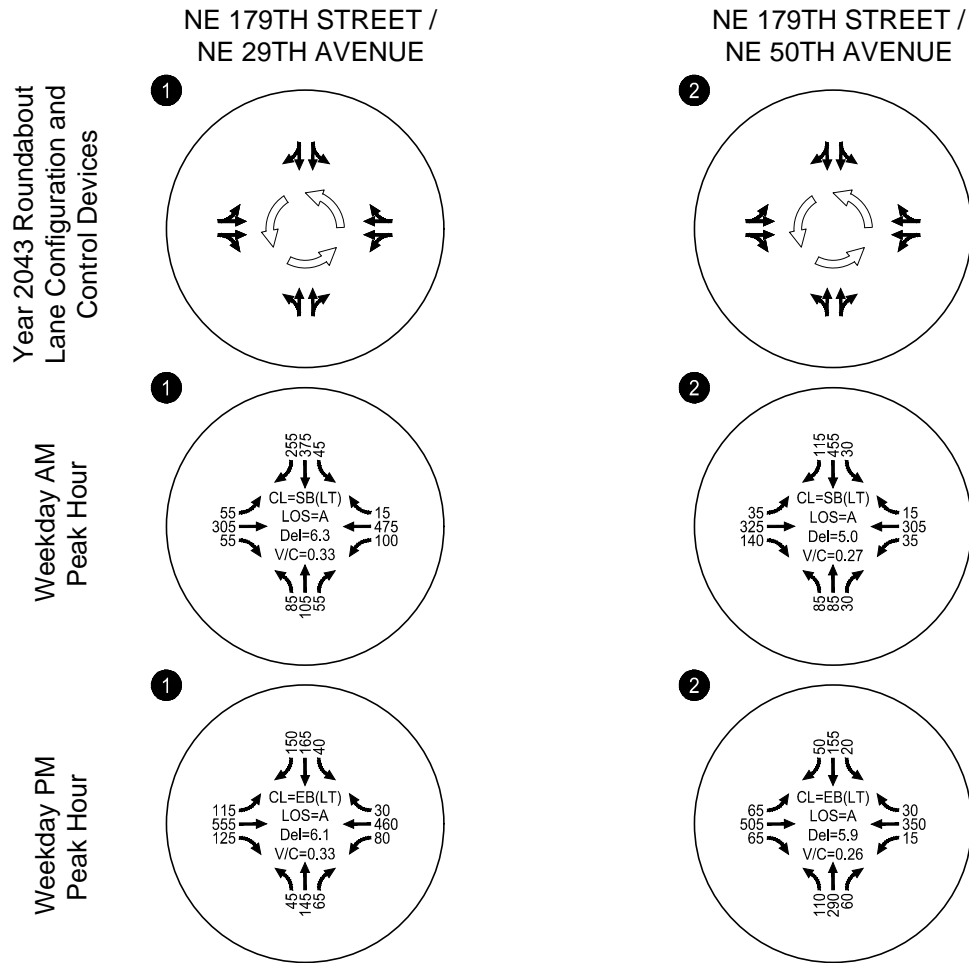
As shown in Table 4, for each intersection the roundabout alternative has substantially lower control delay than the signalized intersection alternative. During off-peak periods, the control delay for the roundabout alternatives is likely to be even lower than the control delay for the signalized alternatives; this is captured in the life-cycle cost estimation presented later in this report.



Year 2043 Signalized Lane Configurations and Traffic Conditions
Weekday AM and PM Peak Hours
Clark County, WA

Figure
5

LOS = INTERSECTION LEVEL OF SERVICE
Del = INTERSECTION AVERAGE CONTROL DELAY
V/C = INTERSECTION VOLUME-TO-CAPACITY RATIO



**Year 2043 Roundabout Lane Configurations and Traffic Conditions
Weekday AM and PM Peak Hours
Clark County, WA**

**Figure
6**

LOS = INTERSECTION LEVEL OF SERVICE
Del = INTERSECTION AVERAGE CONTROL DELAY
V/C = INTERSECTION VOLUME-TO-CAPACITY RATIO

RECONSIDERATION OF FUTURE PLANNED IMPROVEMENTS ALONG NE 179TH STREET

Future planned improvements along NE 179th Street indicate that this corridor will have a five-lane cross-section. Based on the year 2043 traffic operations analyses, it is unusual for a 20-year analysis showing signal and roundabout alternatives to operate at LOS A/B. To investigate further, Kittelson conducted a sensitivity analysis with a three-lane cross-section along NE 179th Street, assuming traffic signals with one through lane in each direction and single-lane roundabouts. The sensitivity analysis shows the signals and roundabouts to operate at LOS B/C in the year 2043 with remaining capacity flexibility. Kittelson understands that the five-lane versus three-lane discussion is outside the scope of this project but recommends that the County revisit future planned improvements along NE 179th Street.

SAFETY PERFORMANCE ANALYSIS

Kittelson prepared a safety performance analysis to determine the predicted crash frequency at each of the study intersections. At the NE 29th Avenue and NE 50th Avenue intersections with NE 179th Street, a traffic signal was compared with a multilane roundabout. As noted earlier, these are planning-level projections and as such do not get into the level of design detail specific to the alignments of the alternatives.

The fatal/injury crashes and property damage only (PDO) crashes reported for each intersection for the opening year 2023 through horizon year 2043 are provided in Table 5. Output summary reports are in Appendix J.

Table 5. Predicted Crashes and Safety Cost for Alternatives from Opening Year 2023 to Horizon Year 2043

Intersection	Alternative	Crash Severity	Opening Year 2023 (crashes per year)	Horizon Year 2043 (crashes per year)	Total Project Life Cycle (total crashes)
NE 179 th Street / NE 29 th Avenue	Signal	Total	0.86	2.12	31
		Fatal & Injury	0.28	0.70	10
	Roundabout	Total	0.70	1.72	25
		Fatal & Injury	0.08	0.20	3
NE 179 th Street / NE 50 th Avenue	Signal	Total	0.68	1.42	22
		Fatal & Injury	0.22	0.46	7
	Roundabout	Total	0.55	1.15	18
		Fatal & Injury	0.06	0.13	2

The following differences in intersection safety performance are anticipated between 2023 and 2043:

- At the NE 29th Avenue intersection, the signal alternative is predicted to have approximately seven more severe crashes (fatal or injury), as well as more PDO crashes than the roundabout alternative.
- At the NE 50th Avenue intersection, the signal alternative is predicted to have approximately five more severe crashes (fatal and injury), as well as more PDO crashes than the roundabout alternative.

The estimated costs to society for these various crash types are discussed further in the life-cycle cost estimation presented later in this report.

ALTERNATIVES DEVELOPMENT

NE 179TH STREET/NE 29TH AVENUE CONCEPTUAL LAYOUTS AND COSTS

Clark County developed the initial traffic signal and multilane roundabout alternatives for the NE 179th Street/NE 29th Avenue intersection. Functional layouts are provided in Appendix K. Conceptual layouts of traffic signal and multilane roundabout alternatives are presented in Figures 7 and 8, respectively.

Figure 7. Conceptual Layout of Traffic Signal Alternative

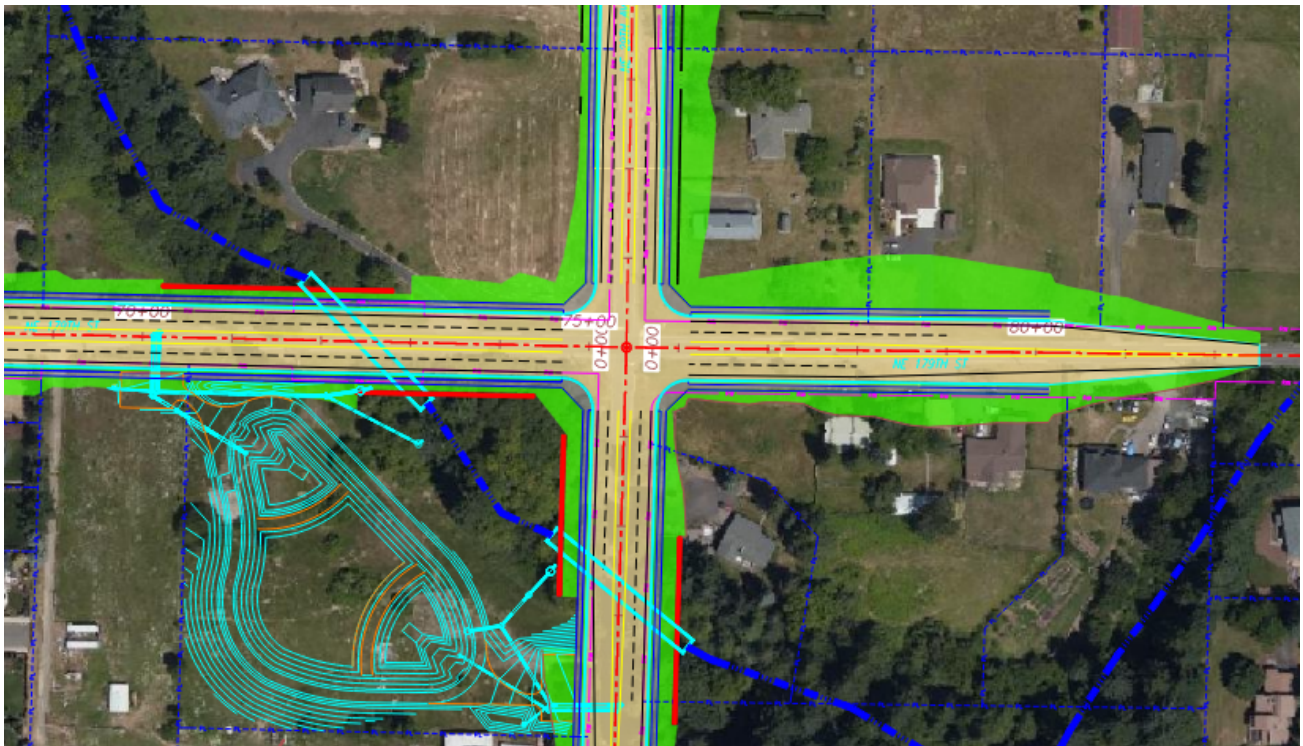
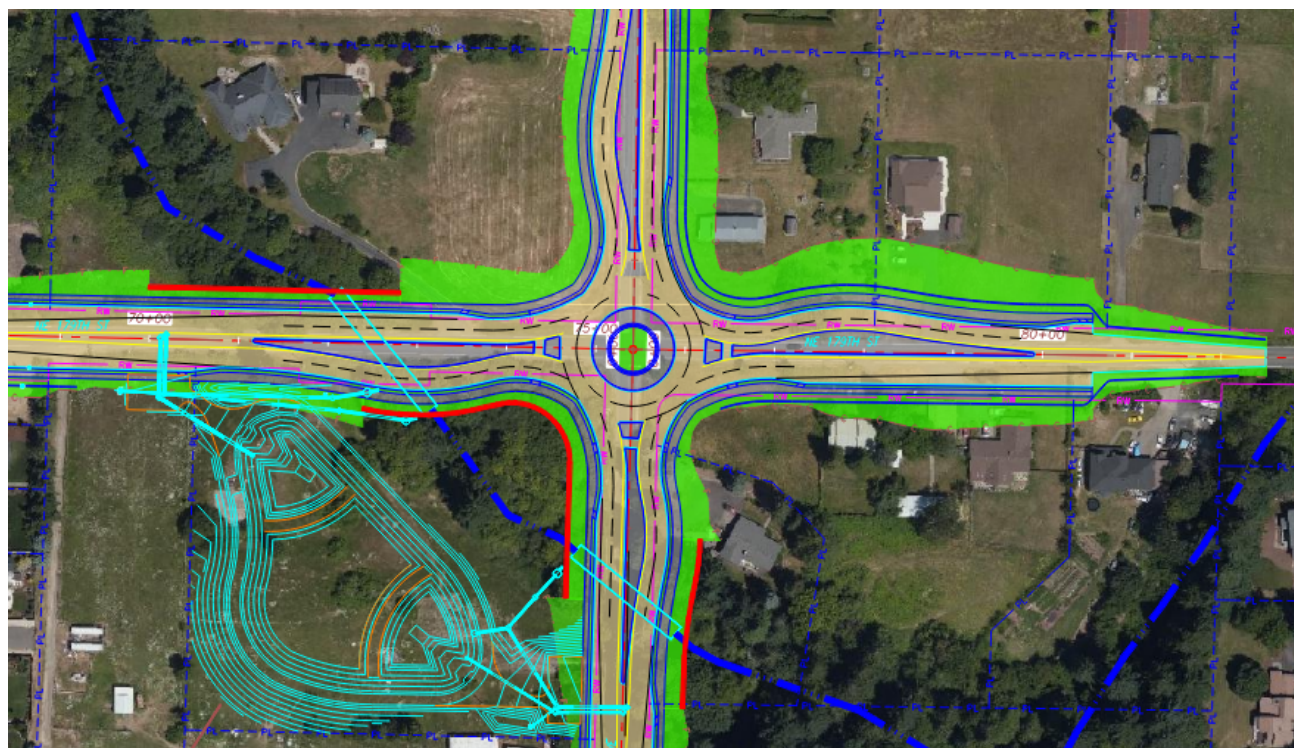


Figure 8. Conceptual Layout of Multilane Roundabout Alternative



Clark County provided planning-level construction, as well as right-of-way acquisition and environmental impact cost estimates as summarized in Table 6.

Table 6. NE 179th Street/NE 29th Avenue: Summary of Project Costs

Description	Traffic Signal Alternative	Multilane Roundabout Alternative
Construction cost	\$15,037,919	\$14,668,485
Right-of-way acquisition	\$2,024,536	\$2,284,775
Environmental impact cost	\$1,677,600	\$1,930,800
Preliminary Total Cost:	\$18,740,055	\$18,884,040

Planning-level construction and right-of-way & environmental impact costs are in Appendix L.

NE 179TH STREET/NE 50TH AVENUE CONCEPTUAL LAYOUTS AND COSTS

Clark County developed the initial traffic signal and multilane roundabout alternatives for the NE 179th Street/NE 50th Avenue intersection. Functional layouts are provided in Appendix M. The conceptual layouts of traffic signal and multilane roundabout alternatives are presented in Figures 9 and 10, respectively.

Figure 9. Conceptual Layout of Traffic Signal Alternative

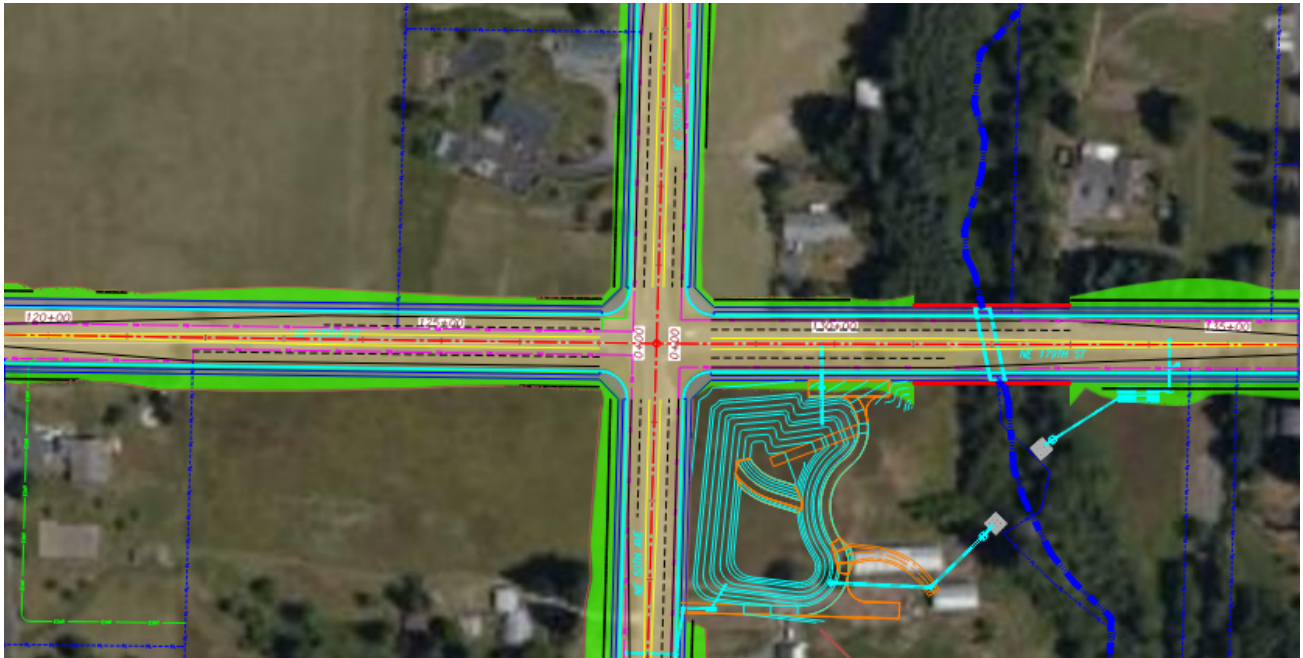
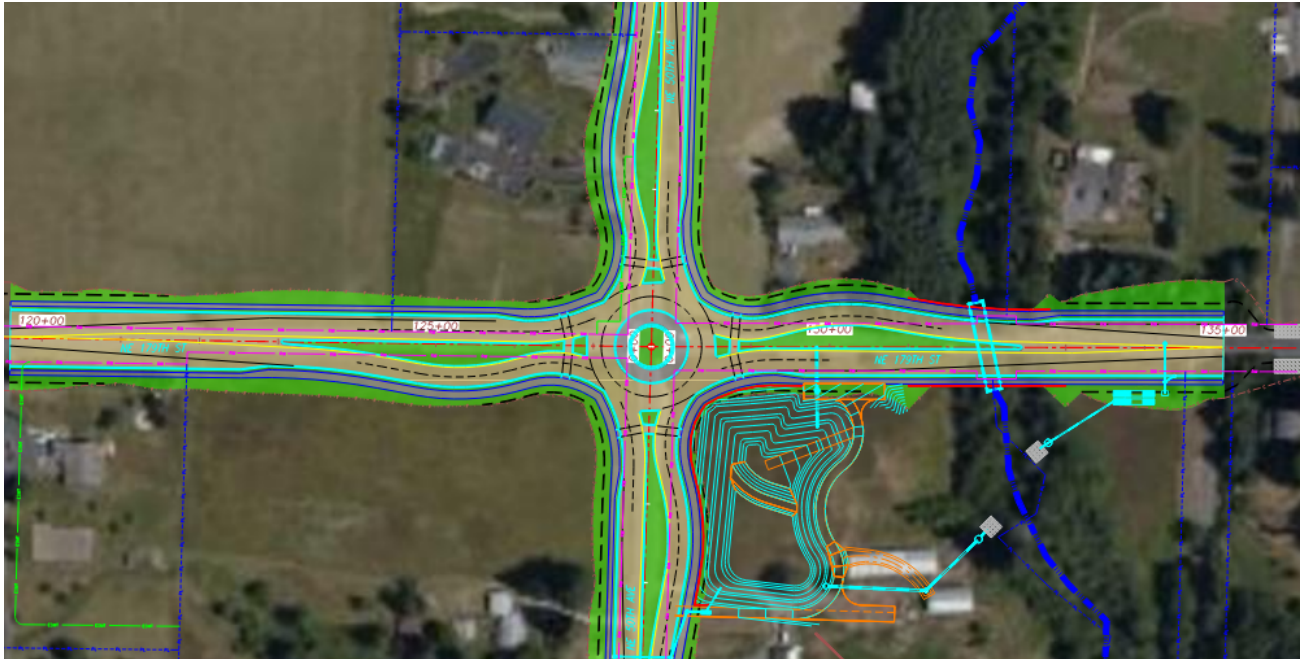


Figure 10. Conceptual Layout of Multilane Roundabout Alternative



Clark County provided planning-level construction, as well as right-of-way acquisition and environmental impact cost estimates as summarized in Table 7.

Table 7. NE 179th Street/NE 50th Avenue: Summary of Project Costs

Description	Traffic Signal Alternative	Multilane Roundabout Alternative
Construction cost	\$9,705,332	\$9,590,594
Right-of-way acquisition	\$1,297,120	\$1,437,099
Environmental impact cost	\$857,600	\$989,600
Preliminary Total Cost:	\$11,860,052	\$12,017,293

Planning-level construction and right-of-way & environmental impact costs are in Appendix N.

ROUNABOUT GEOMETRY REFINEMENT

Kittelson reviewed the initial functional roundabout layouts and has the following preliminary observations:

- The approach alignment can be offset to the left to minimize the need for chicanes, likely reducing property and natural resource impacts.
- The lane configurations for the roundabouts have undesirable concentric striping and there are opportunities to provide the necessary channelization to reduce driver workload.
- Based on the year 2043 traffic operations analysis, the roundabouts can operate as single-lane facilities while maintaining future capacity flexibility. The single-lane roundabouts will be smaller. Speed control at the entries is easier compared to multilane roundabouts. It's also simpler to integrate pedestrians at single-lane roundabouts, where they only need to cross one lane at a time.

Kittelson will work with County staff to update and refine the roundabout geometry based on the most recent national best practices that are consistent with WSDOT roundabout design guidance

LIFE-CYCLE COST ANALYSIS

Kittelson conducted a life-cycle cost analysis to compare benefits and costs for opening year 2023 through horizon year 2043 for each alternative. Life-cycle costs include hard costs incurred by the County (construction, right-of-way acquisition, operations, and maintenance) and soft costs incurred by society (value of users' time, crash costs). Kittelson applied a discount rate of 3 percent to all future costs to calculate the net present value of the costs. The generally assumed costs are summarized below.

The assumed 20-year operations and maintenance costs are as follows:

- Traffic Signal:
 - Signal retiming: \$5,000 every 3 years
 - Lighting: \$1,000 annually
 - Signal Maintenance: \$4,000 annually
- Roundabout:
 - Lighting: \$3,000 annually
 - Roundabout landscaping: \$2,000 annually

Note that in addition to the above costs, the signal alternative may require significant investments from time to time that go beyond periodic maintenance, such as the cost to replace system components such as detection systems. Replacement of these systems, which can cost \$50,000 or more, come from maintenance funds rather than capital funds. As such, the life-cycle cost for operations and maintenance for the signalized intersection alternative may be higher than estimated in this analysis.

The assumed costs to society for delay and crashes are as follows:

- Value of time (delay costs): The delay costs were based on value of user time from the 2015 Texas Transportation Institute *Urban Mobility Report*.
 - Person (\$ per person hour): \$17.67
 - Trucks (\$ per truck hour): \$94.04
- The costs of a severe (fatal or injury) crash and PDO crash are estimated to be \$158,200 and \$7,400, respectively, based on the Highway Safety Manual. The cost for severe (fatal or injury) crashes represents an aggregate of fatal, severe injury, and minor injury crashes to be consistent with the crash prediction methods.

The following tables and exhibits summarize the estimated life cycle costs over a 20-year period as well as the benefit-cost compared with the traffic signal alternative. The delay costs represent annualized delay estimates and thus capture the effect of both peak period and off-peak period times throughout the year. Construction and right-of-way are one-time costs at the time of construction while the delay and operations and maintenance costs are estimated projections for the opening year 2023 through horizon year 2043.

The results provide a relative comparison of the intersection control types (traffic signal and multilane roundabout) for decision-making purposes. Life cycle cost calculations are provided in Appendix O.

NE 179th Street/NE 29th Avenue Life Cycle Cost Analysis

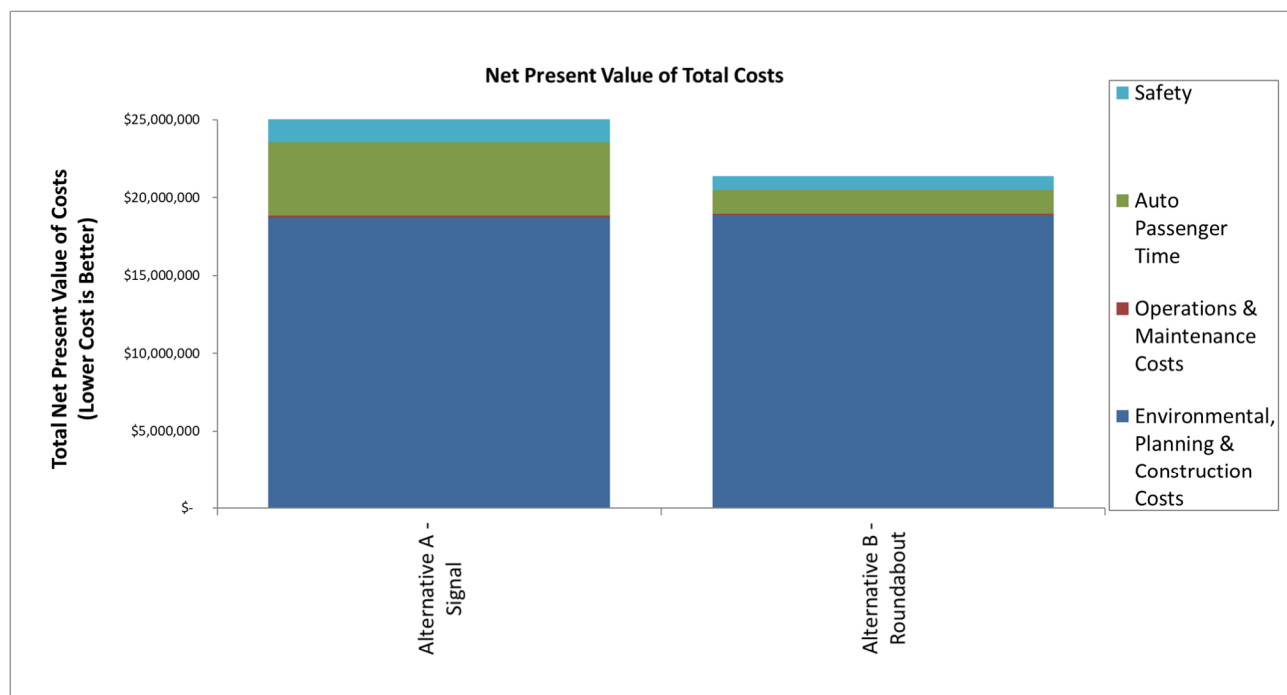
Table 8 summarizes the life cycle considerations associated with traffic signal and roundabout alternatives at the NE 179th Avenue/NE 29th Street intersection. The roundabout alternative has a lower total net present value compared to the signalized intersection alternative. Note that while the capital costs are very similar between the alternatives and are shared between Clark County and WSDOT, ongoing costs are paid solely by Clark County.

Table 8. NE 29th Avenue Intersection – Roundabout Life-Cycle Cost Analysis Benefits Relative to Signal Alternative

Control Strategy	Alternative A - Signal	Alternative B - Roundabout
Construction Cost	\$18,740,000	\$18,880,000
Operations & Maintenance Costs	\$100,000	\$70,000
Delay	\$4,730,000	\$1,510,000
Safety	\$2,860,000	\$920,000
Total Net Present Value	\$26,430,000	\$21,380,000

Exhibit 1 shows that while the initial investment in the roundabout is comparable to that for the signal, the roundabout has lower long-term operations and maintenance costs and substantially lower delay and safety costs over the life of the project. This results in a lower net present value overall.

Exhibit 1. NE 29th Avenue Intersection – Life-Cycle Cost Analysis, Net Present Value of Total Costs



NE 179th Street/NE 50th Avenue Life Cycle Cost Analysis

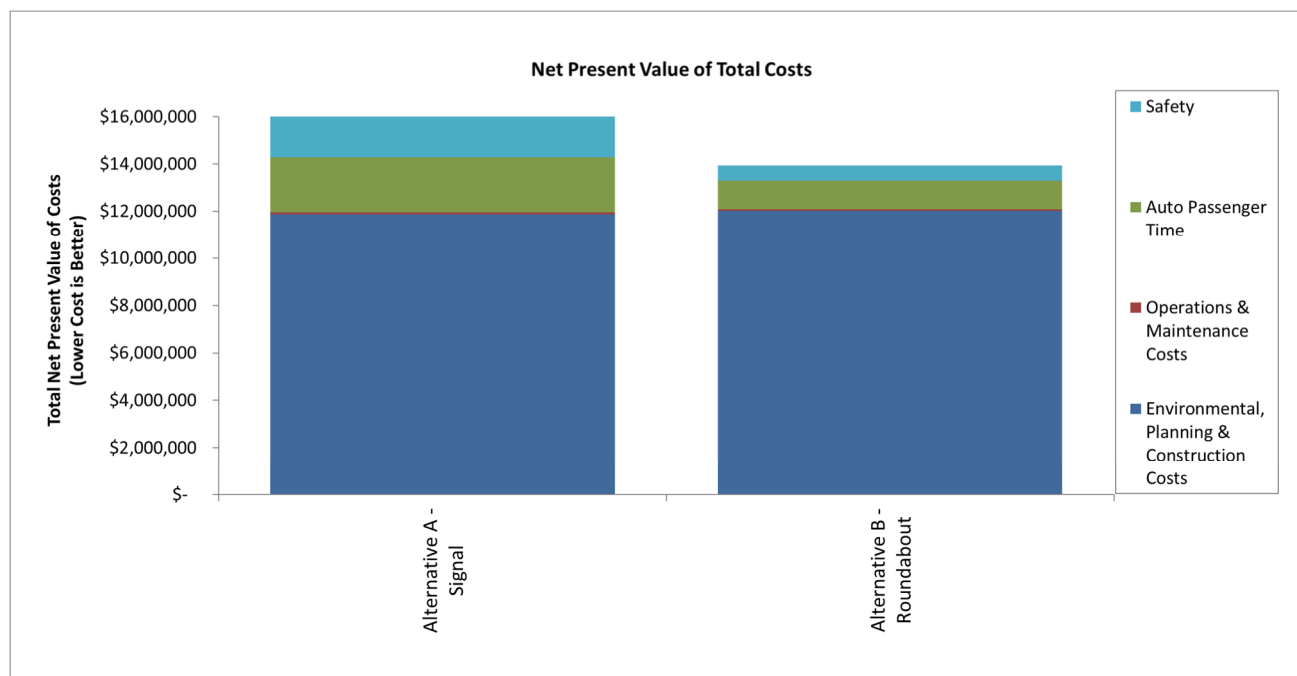
Table 9 summarizes life cycle considerations for traffic signal and roundabout alternatives at the NE 50th Avenue/NE 179th Street intersection. The roundabout alternative has a lower total net present value compared to the signalized intersection alternative. Similar to the NE 29th Avenue intersection, while the capital costs are very similar between the alternatives and are shared between Clark County and WSDOT, ongoing costs are paid solely by Clark County.

Table 9. NE 50th Avenue Intersection – Roundabout Life-Cycle Cost Analysis Benefits Relative to Signal Alternative

Control Strategy	Alternative A - Signal	Alternative B - Roundabout
Construction Cost	\$11,860,000	\$12,020,000
Operations & Maintenance Costs	\$100,000	\$70,000
Delay	\$2,320,000	\$1,210,000
Safety	\$2,050,000	\$640,000
Total Net Present Value	\$16,330,000	\$13,940,000

Exhibit 2 shows that while the initial investment in the roundabout is comparable to that for the signal, the roundabout has lower long-term operations and maintenance costs and substantially lower delay and safety costs over the life of the project. This results in a lower net present value overall.

Exhibit 2. NE 50th Avenue Intersection – Life-Cycle Cost Analysis Net Present Value of Total Costs



FINDINGS AND CONCLUSIONS

This traffic control alternatives analysis compared future traffic control (signal or roundabout) options at the study intersections along the NE 179th Street corridor. The evaluation included intersection operations under existing, opening year 2023, and horizon year 2043 conditions. Safety performance of traffic signal and roundabout intersection configurations was analyzed. Key findings of the study include:

Intersection Operations

- Both intersections would satisfy County operation standards during year 2023 and year 2043 weekday AM and PM peak hour conditions for both traffic signal and multilane roundabout alternatives. Both alternatives have sufficient future reserve capacity to accommodate a wide range of variation in future demand, including unknown effects such as vehicle fleet changes (e.g., connected and autonomous vehicles).
- Based on the year 2043 traffic operations analyses, it is unusual for a 20-year analysis showing signal and roundabout alternatives to operate at LOS A/B. To investigate further, Kittelson conducted a sensitivity analysis with a three-lane cross-section along NE 179th Street. The sensitivity analysis shows the signals and roundabouts to operate at LOS B/C in 2043 with remaining capacity flexibility to accommodate unknown variations in future demand.

Predictive Safety Comparison

- At the NE 29th Avenue intersection, the signal alternative is predicted to have approximately seven more severe (fatal or injury) crashes and more property damage crashes than the roundabout alternative over a 20-year period from 2023 through 2043.
- At the NE 50th Avenue intersection, the signal alternative is predicted to have approximately five more severe (fatal or injury) crashes and more property damage crashes than the roundabout alternative over a 20-year period from 2023 through 2043.

Alternative Development

- There are opportunities to update and refine the initial roundabout geometries based on the most recent national best practices to minimize right-of-way and natural resource impacts.

Life Cycle Cost Comparison

- Multilane roundabouts at the NE 29th Avenue and NE 50th Avenue intersections have a lower life cycle cost compared to a traffic signal during the 20-year study period.

Future Planned Improvements along NE 179th Street

- The long-range plan indicates that this corridor will have a five-lane cross-section. Kittelson understands that the five-lane versus three-lane discussion is outside the scope of this project but recommends that the County revisit future planned improvements along NE 179th Street.

Based on the analysis summarized above, Kittelson finds that the roundabout alternatives for both intersections are expected to perform better than the signalized intersection alternatives for the NE 29th Avenue and NE 50th Avenue intersections within the NE 179th Street corridor project.

Please contact us if you have any questions regarding the study analysis or findings.

REFERENCES:

1. Washington State Department of Transportation (WSDOT). WSDOT Design Manual, Chapter 1300: Intersection Control Type. July 2018.
2. Transportation Research Board. *Highway Capacity Manual*, Sixth Edition. Washington, DC, 2016.
3. WSDOT. WSDOT Traffic Analysis Guidebook. February 2019.
4. WSDOT. "WSDOT Synchro & Simtraffic Protocol." August 2018.
5. WSDOT. "WSDOT Sidra Policy Settings." October 2019.
6. Federal Highway Administration. Safety Performance for Intersection Control Evaluation (SPICE). Version 1.4. October 2018.
7. American Association of State Highway Transportation Officials (AASHTO). *Highway Safety Manual*, First Edition. Washington, DC, 2010.
8. WSDOT. Safety Analysis Guide. September 2017.
9. Rodegerdts, L. A., J. W. Bessman, D. B. Reinke, M. J. Kittelson, J. K. Knudsen, C. D. Batten, and M. T. Wilkerson. Estimating the Life-Cycle Costs of Intersection Designs. NCHRP Web-Only Document 220, Transportation Research Board of the National Academy of Sciences, Washington, DC, 2016.

APPENDICES:

- A. RTC Transportation Demand Model Printouts
- B. 2023 and 2043 Traffic Volume Projections
- C. Traffic Counts
- D. Existing Conditions
- E. Crash Data
- F. 2023 Traffic Conditions - Signal Concept
- G. 2023 Traffic Conditions - Roundabout Concept
- H. 2043 Traffic Conditions - Signal Concept
- I. 2043 Traffic Conditions - Roundabout Concept
- J. Safety Performance Printouts
- K. Functional Layouts for NE 179th Street/NE 29th Avenue Intersection
- L. Planning-Level Costs for NE 179th Street/NE 29th Avenue Intersection
- M. Functional Layouts for NE 179th Street/NE 50th Avenue Intersection
- N. Planning-Level Costs for NE 179th Street/NE 50th Avenue Intersection
- O. Life-Cycle Cost Printouts